DOCUMENT RESUME

ED 134 461 SE 021 939

TITLE	Science Curriculum Guide, Levels 1 and 2.
INSTITUTION	Newark School District, Del.
PUB DATE	Sep 75
NOTE	158p.; For related documents, see SE 021 940-941; Contains marginal legibility; Bibliography has been removed due to marginal legibility
EDRS PRICE	MF-$0.83 HC-$8.69 Plus Postage.
DESCRIPTORS	*Curriculum Guides; Educational Objectives; *Elementary School Science; *Elementary Secondary Education; Enrichment Activities; General Science; Intermediate Grades; Primary Education; *Science Activities; *Science Curriculum; Science Education; Scientific Concepts; Secondary School Science

ABSTRACT

The first two of four levels in a K-12 science curriculum are outlined. In Level 1 (grades K-2) and Level 2 (grades 3-5), science areas include the study of living things, matter and energy, and solar system and universe. Conveniently listed are page locations for educational and instructional objectives, cross-referenced to science area and coded for concept. Six major themes provide the basis for study in all levels (K-12). These are: Change, Continuity, Diversity, Interaction, Limitation, and Organization. Coded objectives are included for each theme. Activities are suggested for particular objectives selected from the areas of science listed above and emphasizing scientific processes. Listed for each group of objectives are notes that provide information regarding associated career emphasis, possible community resources, reading enrichment, field trips, films, role-play situations, etc. The appendices include: Appendix I, recommended time allotments for science (K-8); Appendix II, annotated list of suggested science references (COPES, ESS, SCIS, SAPA, ESSP); Appendix III, general goals of a career-science curriculum; Appendix IV, a written statement regarding non-science theory in science instruction; and Appendix V, an explanation of how to incorporate science into the reading program and develop skills in reading science literature. (CS)

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ED 134161

NEWARK SCHOOL DISTRICT

DISTRICT CURRICULUM GUIDE

SCIENCE CURRICULUM GUIDE
LEVELS 1 AND 2

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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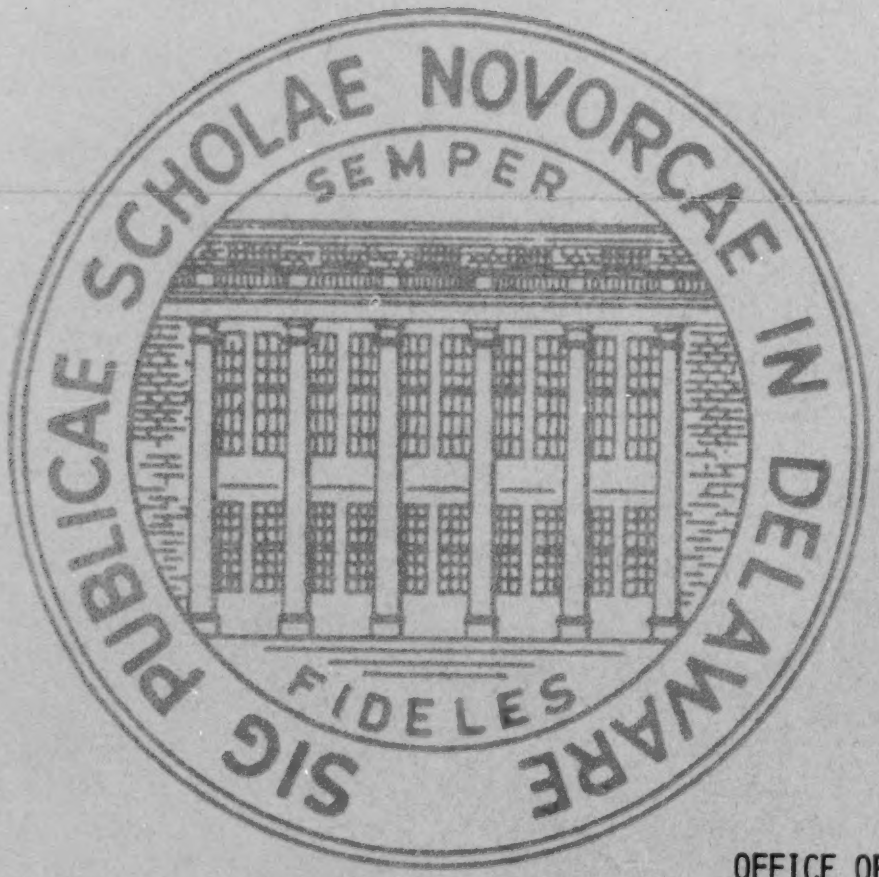

SE 021 939

OFFICE OF INSTRUCTIONAL SERVICES
NEWARK SCHOOL DISTRICT
NEWARK, DELAWARE 19711

DATE: September, 1975

SCIENCE CURRICULUM GUIDE

SEPTEMBER, 1975

NEWARK SCHOOL DISTRICT

NEWARK, DELAWARE

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TABLE OF CONTENTS

FOREWORD	iii
INTRODUCTION	iv
LOCATION OF OBJECTIVES	vii
LEVEL ONE (K - 2)	
Change	One - 2
Continuity	One - 10
Diversity	One - 14
Interaction	One - 17
Limitation	One - 21
Organization	One - 26
LEVEL TWO (3 - 5)	
Change	Two - 2
Continuity	Two - 11
Diversity	Two - 15
Interaction	Two - 22
Limitation	Two - 25
Organization	Two - 30
APPENDICES	
Appendix I	2
Appendix II	3
Appendix III	5
Appendix IV	6
Appendix V	7
BIBLIOGRAPHY	12

FOREWORD

This Science Curriculum Guide is intended to be just that - a guide. While it does not attempt to mandate the entire science program, K-12, it does furnish an overall context for curriculum and instruction. In whatever way science programs are developed in the various schools, the curriculum and instruction should be consistent with two sets of standards: (1) the six curricular and instructional goals* set forth in the 1974 report of the Program Advance Committee and (2) the goals and objectives in this curriculum guide.

This guide should be used as a tool to assist you to develop your curriculum and instruction. By using it as a tool you will increase both your effectiveness and your efficiency.

Loren J. Thompson
Director of Instruction

*The following goals for the foundation of Newark's educational program were accepted by the Board of Education:

Newark's educational program should prepare people who:

- think analytically/critically
- think creatively
- think and act humanistically
- possess basic skills
- can enter the job market and/or further education
- believe in and practice good citizenship

INTRODUCTION

This Science Curriculum Guide has been developed to provide direction to teachers of science in the Newark School District. It fits closely to the goals established by the Science Task Force of the State of Delaware and is patterned in part after the Equinox, a guide prepared by the Department of Public Instruction.

In order to provide flexibility the guide has been organized in four levels: Level One, K-2; Level Two, 3-5; Level Three, 6-8; and Level Four, 9-12. This makes it adaptable to the non-graded school and at the same time permits teachers in the graded system to select goals and objectives suitable to their students' needs.

Six major concepts in science provide the goals for this guide: Change (Ch), Continuity (Co), Diversity (D), Interaction (I), Limitation (L), and Organization (Or). These have been taken from Concepts in Science, developed by Dr. Kenneth Dowling of the State Department of Public Instruction, Madison, Wisconsin. These concepts have been sequenced alphabetically rather than in a logical order of occurrence. Education and instructional objectives have been grouped under these concepts with the understanding that there are areas of overlap.

In addition to the coding of the concepts a decimal outline system has been used with the number to the left of the decimal representing the level. To the right of the decimal two significant places have been used. The tenths place is assigned to the educational objective(s); and the hundredth, the instructional objective(s).

Ex:

Ch 2.30 Change Level Two, third educational objective

D 1.24 Diversity Level One, second educational objective, fourth instructional objective.

Activities suggested for accomplishing the objectives emphasize the processes of science as set forth in Science, A Process Approach. These include: experimenting, observing, communicating, classifying, measuring, predicting, interpreting data, inferring, formulating questions and hypotheses, making operational definitions, and formulating models.

Examples of possible resources have been included under Notes in this guide. For activities in computer simulation one should refer to Appendix B in the district's Computer Curriculum Guide.

A wide variety of suitable community resources: i.e. discussion leaders for the classroom, or tours of facilities, have been cataloged by the Educational

Resources Association (ERA). Teachers need only to contact the ERA office in the administration building to obtain information regarding the desired resource.

In the Notes column of the guide a number of careers have been listed which relate in part to the educational objectives assigned to the concepts. In using the guide teachers may wish to make students aware of these and other careers for which a science background is needed.

Credit for the production of this curriculum guide goes to several classroom teachers as well as to other interested educators. Staff members who assisted in its preparation, either through writing or by leading or participating in workshops include:

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LOCATION OF OBJECTIVES

	Objective	Page
EARTH		
Level 1	Ch 1.60	One - 6
	Ch 1.70	One - 7
	Ch 1.80	One - 8
	Co 1.60	One - 12
	I 1.50	One - 20
	L 1.40	One - 23
	L 1.50	One - 24
	L 1.60	One - 25
	Or 1.50	One - 28
	Or 1.60	One - 29
Level 2	Ch 2.40	Two - 3
	Ch 2.50	Two - 4
	Ch 2.60	Two - 6
	Ch 2.90C	Two - 9
	Co 2.50	Two - 14
	L 2.10	Two - 25
	Or 2.80	Two - 34
	Or 2.90	Two - 34
LIVING THINGS		
Level 1	Ch 1.10	One - 2
	Ch 1.20	One - 3
	Ch 1.30	One -
	Co 1.10	One - 10
	Co 1.20	One - 11
	Co 1.30	One - 11
	D 1.10	One - 14
	D 1.20	One - 15
	D 1.30	One - 15
	I 1.10	One - 17
	I 1.20	One - 18
	L 1.10	One - 21
	L 1.20	One - 22
	L 1.30	One - 23
	Or 1.10	One - 26
	Or 1.20	One - 27

	Objective	Page
LIVING THINGS		
Level 2	Ch 2.10	Two - 2
	Ch 2.20	Two - 2
	Ch 2.30	Two - 3
	Ch 2.90D	Two - 10
	Co 2.10	Two - 11
	Co 2.20	Two - 11
	Co 2.30	Two - 12
	D 2.10	Two - 15
	D 2.20	Two - 17
	I 2.10	Two - 22
	L 2.30	Two - 24
	L 2.40	Two - 24
	L 2.50	Two - 27
	L 2.70	Two - 28
	L 2.80	Two - 28
	Or 2.10	Two - 30
	Or 2.20	Two - 30
	Or 2.30	Two - 31
	Or 2.40	Two - 32
MATTER AND ENERGY		
Level 1	Ch 1.40	One - 4
	Ch 1.50	One - 5
	Co 1.40	One - 12
	Co 1.50	One - 12
	D 1.40	One - 16
	I 1.30	One - 19
	I 1.40	One - 20
	Or 1.30	One - 27
	Or 1.40	One - 28
Level 2	Ch 2.90D	Two - 10
	Co 2.30	Two - 12
	D 2.30	Two - 18
	D 2.40	Two - 20
	I 2.20	Two - 23

	Objective	Page
Matter & Energy (Cont'd.)		
Level 2	I 2.30	Two - 24
	I 2.40	Two - 24
	L 2.20	Two - 25
	L 2.60	Two - 27
	Or 2.50	Two - 32
	Or 2.60	Two - 33
	Or 2.70	Two - 33
SOLAR SYSTEM AND UNIVERSE		
Level 1	Ch 1.90	One - 8
	Ch 1.90A	One - 8
	Or 1.50	One - 28
	Or 1.70	One - 29
Level 2	Ch 2.70	Two - 7
	Ch 2.80	Two - 7
	Ch 2.90	Two - 8
	Ch 2.90A	Two - 8
	Ch 2.90B	Two - 9
	Co 2.40	Two - 13
	Co 2.50	Two - 14
	D 2.50	Two - 20
	D 2.60	Two - 21
	L 2.90	Two - 28
	L 2.90A	Two - 29

SCIENCE CURRICULUM GUIDE

LEVEL 1 (K - 2)

CHANGE

Level One (K-2)

Our environment, living and nonliving, microscopic and macroscopic, is constantly undergoing change.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
Ch 1.10 The appearance and activities of living things vary with the seasons. Ch 1.11 Observe and identify seasonal changes in the appearance and activities of plants and animals.	. Adopt a tree to observe on a regular basis noting weekly, and seasonal changes. . Take photographs of the adopted tree throughout the year for display and discussion. . Classify tree photos according to season. . Make predictions of seasonal changes in living things. . Report observations of seasonal changes in pets (fur length, features, etc.) . Show films or filmstrips on hibernation and animal activities associated with seasonal change. Make direct observations. . Observe changes in man's activities associated with changes in temperature, daylight hours, nature of precipitation, etc.	Careers: Buyer for clothing store Forest Ranger Gardener Pet-store operator Photographer Snowplow driver Sports promoter Weatherforecaster* *Example: plan a trip to a weather bureau. Weather forecaster visit the classroom bringing job-related equipment. Set up weather forecasting center in classroom. Make predictions using the newspaper, radio and TV. Construct a weather instrument (weather vane).

Objectives	Suggested Activities	Notes
	. Observe classroom plants, detecting budding, leafing, flowering cycles.	
Ch 1.20 As living things grow and age they change in form and activity.		Careers: Chick breeder Nursery school attenda Physical therapist
Ch 1.21 Observe living things to discover changes in form and activity with growth and age.	. Observe babies, compare form with that of self and adults. Note relative size of head compared to body. Note length of legs, arms, growth of hair, language development.	
	. Raise monarch butterflies. Observe changes.	Resource: Dennis Reilly Coordinator of Environ mental Education.
	. Observe and record activities of infants, toddlers, classmates, adults: dexterity, method of locomotion, etc.	
	. Observe animals to note changes in form and activities with growth and age. Compare with human growth and activities.	
	. Observe growth cycle of frogs or toads.	
Ch 1.30 Some living things change habitat as they grow and age.		Careers: Fish Industry Wildlife worker
Ch 1.31 Examine the habitat of living things to determine changes.	. After observing change in the form of tadpole, note change in habitat. Determine reason for change.	

Objectives	Suggested Activities	Notes
	. Note change in habitat of monarch butterfly. . Discuss and/or observe bird migration.	
Ch 1.40 The application of forces results in setting matter in motion or in changing its speed or direction.		Careers: Balloon navigator Baseball pitcher Civil Corps of Engineers Clock maker Crane operator Hockey player Operator of display fountain Racing car driver*
Ch 1.41 Apply force to matter and observe the results.	. Experiment with movement of matter in different states. . Apply force to matter in motion, identifying changes in speed and direction. Use inclined plane or cardboard to: .. Change direction of water flowing from tap. .. Change direction of trickle of water flowing down inclined plane by applying force to an object held in the path of the water. .. Change speed of flow of light syrup or water droplet down inclined plane by applying upward or downward force on the plane. .. Use ping pong balls and paddles to show change in direction and speed of rolling balls or thrown balls when force is applied.	* Demonstrate force and its ability to speed up, slow down objects in motion. Use inclined planes and toy cars to simulate race.

Objectives	Suggested Activities	Notes
	.. Using an inflated balloon, observe the change in speed of the escaping air by constricting opening to a greater or lesser degree. .. Use a leaking basketball or inner tube to show the effect of force on the speed of the escaping air. .. Observe effect of air expelled from mouth on the speed of falling feathers, lint, dandelion seeds.	
Ch 1.42 Observe the effects of natural forces and establish causal relationships.	. Discuss gravity as invisible force. Demonstrate. . Observe results of wind and air currents.	See SAPA (Box M)
Ch 1.43 Determine which forces applied create the greatest or least change in the speed or direction of matter in motion.	. Experiment with various types of forces to determine greatest or least amount of change.	
Ch 1.50 Energy is needed to change matter.		Careers: Baker Miller (trip-Dayett Mills) Power plant engineer Snowmaker at ski resort
Ch 1.51 Identify properties of matter that change when energy is added or subtracted.	. Remove heat from water, crush ice. . Fasten balloon on neck of flask. Heat flask and then cool. Observe.	

Objectives	Suggested Activities	Notes
	. Observe ice cubes at room temperature.	What Happens If by Rose Wyler Scholastic pg. 41-46.
Ch 1.60 Wind and water are agents of change which act on the earth's surface.		Careers: Grounds keeper Highway maintenance eng. Hurricane center or "watch" people Public beach manager Soil conservationist
Ch 1.61 Observe the effects of wind and water and experiment to determine changes.	. Observe the land around the school before and after heavy rains.	
	. Make predictions on the effect of rain. Check predictions.	
	. Measure depth and width of gulley. Keep records and determine changes.	See SAPA Program for activities.
	. Devise an experiment for trapping eroding soil. Measure accumulations.	
	. Divert the path of water flow and observe.	
Ch 1.62 Manipulate materials to simulate both long and short-term changes on the earth's surface.	. Observe a pile of earth to see the effect of rain and wind in spreading or carrying away soil. Make your own experimental sandpile and use a fan to produce wind. Use a sprinkler to simulate rain.	
	. Use a rock tumbler to demonstrate wear and tear on different types of rocks.	Use Crisco can with tight fitting lid and let children be the energy source.

Objectives	Suggested Activities	Notes
	. Put rocks in sock and crush with hammer. Examine results.	People and Their Environment - Teacher's Curric. Guide to Conservation Education.
	. Make earth layers, imbed fossils, use different types of soil. Create your own time zones. Later simulate earthquake with your earth layers.	Film: "Earthquake" (DPI
Ch 1.70 Major changes in the earth's crust usually occur over long periods of time, but violent changes can occur in short time intervals.	. Make volcano (baking soda and vinegar)	Caution: Do not use ammonium dichromate, i has toxic properties.
Ch 1.71 Recognize land forms that are due to long term changes on the earth's surface.	. Take a walk with a local geologist to observe common or unusual land-forms that were created over long periods of time.	Careers: Blasting crew for road jobs Conservation technician Geologist Mountain climber/ explorer Open pit miner Seismologist
	. Investigate layers of earth to discover types of rocks and materials found at different levels.	
	. Show films and pictures to highlight discussion of smooth and jagged rocks, peaked and rounded mountains.	
	. Inspect rocks and sand found in creek or stream bed, infer probable history.	
	. Collect rocks and explain observable differences such as well rounded as compared to very angular. Why are they different?	

Objectives	Suggested Activities	Notes
Ch 1.80 Daily motion of earth causes an "apparent" change in the relative positions of celestial bodies as viewed from earth.		Careers: Astronomer Aviator Navigator Planetarium operator* *Ora Schultz
Ch 1.81 Observe celestial motions of sun, moon and stars in planetarium sky and try to compare these with observations of the real sky.	. Report on observations of sun, moon and stars setting in west. . Record observations on "apparent" motions of Dippers and Queen in Northern Sky through one night of time.	Planetarium is used for this activity by speeding up time lapse to observe this motion.
Ch 1.90 Some stars (seasonal constellations) "appear" to rise and set.		
Ch 1.91 Make observations of constellations setting in west at time of planetarium visit.	. In planetarium, by speed-up motion of earth's rotation, (daily motion) pupils will observe the setting of seasonal constellations in west.	
Ch 1.90 A The moon, a satellite of the earth, goes through "phases" as it revolves around the earth.		Careers: Astronauts Have students role-play landing on the moon. How would the astronauts walk? What would they need?

Objectives	Suggested Activities	Notes
Ch 1.91 A Observe the "apparent" change in shape of the moon by watching nightly.	. Use models of earth, sun, moon positions to demonstrate moon phases; new, crescent, half and full. . Demonstrate positions of earth, moon and sun with small scale planetarium or by using the children or styrofoam balls, etc.	The Moon Seems to Change (Science- I can read. series)

CONTINUITY

Level One (K-2)

There is constancy in cause-and-effect relationships which precludes any abrupt reversal in natural phenomena.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
Co 1.10 Living things reproduce their own kind. Co 1.11 Observe many classes of animals, both live and in pictures to make comparison of likeness in parent and offspring.	. Devise a game so that children match pictures of young animals and their parents. Provide supplies for children to draw or paint pictures of animals and their offspring. (Use magazine pictures.) Have students make a booklet "Living Things Reproduce Their Own Kind." . Match pictures of young plants to mature plants by observing characteristics such as leaf form arrangement, veins, etc. . Discuss plants and animals that have an intermediate stage where the offspring doesn't show great similarity to the adult. Use examples of butterfly, tadpole, fern, seed leaf, etc. . Visit a farm to inspect live animals and their offspring. . Take cuttings from plants such as begonia, coleus, philodendron, azalea to reproduce a plant for gift for Mother's Day. Allow six weeks.	Careers: Gardener* Hatchery attendant (fish & chicken) Nurse Pediatrician Seeds salesperson Veterinarian *Example: Have gardener come to class and discuss how it is possible to distinguish between food seedlings and weeds. Have children plant flats of seeds from both food plants and weeds (mixed up). Later they can carefully identify the food seedlings to leave in the flat by comparing leaf structure or arrangement, color, relative size, etc., to parent food plant. People and Their Environment, Teacher's Curriculum Guide to Conservation Education.

Objectives	Activities	Notes
	. Identify seeds from different plants, choose some to plant, observe. . Categorize animals (from lists, pictures and specimens) as viviparous (live-bearer) or oviparous (egg-layer).	
Co 1.20 Reproduction is an essential process of all living things.		Careers: Conservationist Greenhouse worker Poultry farmer
Co 1.21 Establish reproduction as primary among the processes of living things.	. Identify important processes of living things. Discuss importance of reproduction for survival of a species.	
Co 1.30 Living things exhibit hereditary/instinctive behaviors.	. Compare responses of duckling and kitten when placed in water.	Careers: Animal Behaviorist Psychologist
Co 1.31 Observe, discuss, and classify behavior showing evidence of heredity/instinct.	. Compare method of movement of fish with that of bird. . Observe nursing or feeding behaviors in new-born animals. . Observe grasping behavior in infants. . Investigate instinctive behaviors of birds.	Book - Birds Do the Strangest Things

Objectives	Suggested Activities	Notes
Co 1.40 Matter can be changed in position, motion, shape and other conditions and still retain its identity.		Careers: Cook Glassblower Ice cream person Mason Sculptor
Co 1.41 Experiment with changes in position, motion, shape of matter, to draw conclusions as to its retention of identity.	. List the physical properties of matter before and after imposing changes: .. Dissolve sugar, salt - taste. .. Freeze water and other substances - use senses individually to identify (taste, smell, feel) .. Crush ice - use senses to identify. .. Mold clay from block - make into ball, flatten make cylinder, etc.	
Co 1.50 Changes in position, motion, shape and other conditions do not change the quantity of matter.		Careers: Brick-layer Construction worker Magician
Co 1.51 Measure the quantity of matter before and after imposing conditions of change in position, motion, shape.	. Perform "Piaget type" experiments of conservation of matter. Measure and discuss.	
Co 1.60 Events on earth often occur with dependable regularity.		Careers: Orchard operator Ship captain TV newscaster Wildlife manager

Objectives	Suggested Activities	Notes
Co 1.61 Identify events that occur with regularity.	. Relate events with which children are familiar that occur regularly (day, night, seasons, temperatures, sleep patterns). . Investigate tidal movements. Ex. Photographs and water marks. . Explore calendar to find holidays and birthdays that occur each year. . Observe the seasonal appearance of birds and their nesting habits. . Observe the patterns (phases) of the moon from month to month. . Discuss and classify activities of plants according to seasons (budding, flowering, fruiting, dropping leaves). . Explore star patterns and apparent movement.	Careers cont'd.: Beach manager Clam diggers Crabbers Off shore drillers Ski resort manager
Co 1.62 Observe regularly occurring events on earth and determine time elements involved.	. Note hours of sunrise, sunset. Note dates of first day of fall, winter, spring and summer.	

DIVERSITY

Level One (K-2)

The vast number of natural phenomena which can be observed display a wide variety of similarities and differences.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
D 1.10 Living things are either plant or animal, both differing in structure, function and habitat.		Careers: Anthropologist Farmer Gardener Hunter Pet shop operator Zoologist
D 1.11 Classify living things as either plant or animal by considering structure, function, and habitat.	. Observe and discuss characteristic structures, and functions common to known plants. Observe and discuss characteristics common to animals. Use films and pictures of unusual plants and animals for comparison. (Elodea, Venus fly-trap, starfish, hydra). . Explore diversity in human animals - similarities and differences of races. . Explore similarities and differences in the class: emotion, basic needs, food preferences, eye color, hair, skin, height, weight, handedness, learning rates, skills, etc. . Observe diversity in appearance and use of structural appendages of animals.	Farm Trip - Have students classify each living object they see on the farm as either plant or animal.

Objectives	Suggested Activities	Notes
	. Observe similarities and differences in structure and function of parts of plants.	
D 1.20 Living things are interrelated with the living and nonliving factors in their environment.		Careers: Cattle rancher Power plant engineer Zoo attendant
D 1.21 Recognize relationships of living things to the living and nonliving factors in their environment.	. Classify things in the environment as living or non-living. . Investigate the food of a specific animal: carnivore or herbivore. . Investigate interrelationships among living things. . Investigate man's relationship to soil and fuel energy.	
D 1.30 Each living thing has optimal environmental factors.		
D 1.31 Experiment with environmental factors observing the impact.	. Experiment with plants: tropical desert, local. Vary environment to discover optimal conditions: humidity, heat, darkness, position in space, position in soil, etc. . Discuss environmental requirements of man and certain animals. . Discuss the interdependence of private and public service workers to man's optimal environment.	Careers: Air-conditioning sa person Builder Farmer Furnace repairperso Greenhouse operator Oil deliverer

Objectives	Suggested Activities	Notes
	. Experiment with earthworm boxes. Vary the activity to show ideal living conditions.	S.G.A. Teachers Publication Corp., p. 6.
D 1.40 Similarities and differences of matter can be discovered by use of the senses and can be compared by measurement.		Careers: Chemist Inspector of weights and measures Pharmacist
D 1.41 Use senses to discover similarities and differences of matter.	. Observe or describe the properties of solids, liquids and gases.	
	. Discover properties common to materials in each of the three physical states.	
	. Use a yardstick balance to demonstrate that air in a balloon has weight.	S.G.A. Teachers Publication Corp.
	. Inflate a balloon, cool it, observe.	S.G.A. Teachers Publication Corp.
	. Classify materials as solid, liquids, or gases.	
	. Discuss similarities and differences discovered through the use of the senses.	
D 1.42 Use simple measuring devices to discover the similarities and differences of matter.	. Develop measuring devices using own units. Compare results of measuring common objects.	
	. Research original sources of various common units.	

INTERACTION

Level One (K-2)

The interactions of living and non-living matter in an environment and the resulting exchange of energy determine the nature of the environment.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
I 1.10 Animals get food from plants or other animals. I 1.11 Identify food source(s) of various animal populations.	. Take a fall nature walk to observe squirrels storing nuts, birds eating berries. . Keep aquarium with live plants and fish. Include snails that feed on plants and algae. Observe. Try experiment with fish not being fed after aquarium is well established. Observe and explain. . Investigate source of food used to keep gerbils. What is in a box of commercial food? Identify seeds and their corresponding plant origins. . Discuss food chain of man. Identify sources of major food groups. Classify and record food groups; trace origin. . Have each child choose an animal population to study and record eating habits. Draw pictures or cut out pictures to illustrate food chain.	Careers: Animal caretaker Cannery-food process Feed manufacturer Fish Farmer Marine Studies (Univ. of Delaware Naturalist Nutritionist* Supermarket worker** *Example: Make children aware that food is one of 3 basic needs of a family. Collect pic tures & classify eac into basic food grou Make "nutrition trai ie, children cut pic tures to paste on train cars repre-senting food groups. **Example: Have each student select a favorite fo After a trip to a supermarket have a student list or des-cribe all the worker that have been in-volved in getting that particular food to the child.

Objectives	Suggested Activities	Notes
I 1.12 Distinguish between groups of animals that require a majority of food from plants or a majority from animals.	. Construct a three category classification to illustrate food chain: plants exclusively, animals exclusively, combination of both. . Play a matching game of classifying pictures of animals to food sources - plants, animals, or both. . Identify characteristic structural features that help to classify an animal to its type of food source, ie. herbivore, carnivore. (Beaks, teeth, stomachs, etc.)	
I 1.20 Similar physical environments result in inter-related biological communities.		Careers: Barge captain Beach attendant* Flower grower Horticulturist Landscape gardener Weed inspector
I 1.21 With selected similar physical environments observe and classify the similarity occurring in the biological communities of these related physical environments.	. Plan field trips to two similar environments for comparison of like, or similar animal and plant population. .. pond, lake, creek, river .. garden - woods .. playground - lawn or yard .. sandy area - beach . Visit (via films, filmstrips, and picture books) desert areas, swamp, beach, mountains, and plains. Note vegetation and animal populations. Make predictions about what we would expect to find in animal population. . Interview "authorities" about animals to find if predictions are true. Invite zoologist, hunter, fisherman, etc.	*Example: State parks and recreation association personnel to show slides and discuss their jobs. Relate importance of recreation for health of man; also protection and preservation of environment.

Objectives	Suggested Activities	Notes
I 1.22 Using a particular (Ecosystem) biological community, investigate the inter-relationships of each element of the community, ie., food chains, parasite and or symbiotic relationships and co-existence.	. Using rings or circles to delineate an area, have children dig and gather a sample of an underground community. Identify components in the sample and investigate possible inter-relationships.	
I 1.23 Compare different physical environments to observe the diversity in biological communities.	. Arrange for half of the class to visit or study a selected biological community and the other half to observe a very different type of biological community. Discuss and compare. Note growth patterns of plants that may be similar yet develop at different rates due to environment. Note absence of certain species in one environment.	
I 1.30 Force is the result of the interaction of matter and can only be detected by its effect on matter.		Careers: "Ice cutter" captai Mechanic Scrap iron worker Stone cutter - quarry worker Well driller
I 1.31 Conclude that the interaction of matter results in an identifiable force. In a series of experimental conditions with matter and force, identify those forces that can be detected.	. Observe interaction and identify force in each of the following: .. Bring a magnet near nails, paper clips, pins. .. Release object held in hand. .. Release a toy car at the top of an incline.	

Objectives	Suggested Activities	Notes
I 1.40 There are many forces acting upon matter at the same time.		Careers: Machinist Sailboat operator Trucker
I 1.41 Describe and identify the various forces acting upon an object at the same time.	. Use a magnet to pick up a chain of articles. Determine what other forces limit the number of items in the chain. . After observing the attraction between a magnet and a heavy piece of iron, attempt to lift the iron with the magnet. Identify the force that hinders completion of task.	
I 1.50 The earth is dependent on sunlight (energy from the sun) without which it would become a cold, dark, lifeless object.		Careers: Greenhouse operator Oceanographer Solar engineer
I 1.51 Name various ways in which the earth depends on energy from the sun.	. Discuss needs for sunlight, relating needs to student. . Choose several common objects in the room and investigate origin and relationships to the sun (pencil, paper, water from fountain, plants, fish from aquarium, clothing, chalk).	
I 1.52 Experiment to determine life forms dependent on sunlight, directly or indirectly.	. Experiment with plant growth with and without light - with and without heat from sun. . Experiment with lower forms of life - insects, guppies - to see if they need light, or food produced in presence of light.	

LIMITATION

Level One (K-2)

Natural phenomena are limited by the fundamental nature of matter and energy. There is an overall tendency toward random distribution of energy and a corresponding tendency toward equilibrium in an environment.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
L 1.10 The ability of living things to adapt to changes in their environment is limited.		Careers: Biologist Botanist Forest ranger Medical doctor Tree surgeon*
L 1.11 Recognize adaptations in animals and plants.	. Inspect plants growing outdoors during a very dry spell. Are the leaves curled? Notice in particularly hot weather compared to leaf action in humid weather. . Take walks in densely wooded areas to look for trees that ordinarily grow straight but are misshapen due to search for light - leaning or curved toward a clearing in the foliage. . Observe an anole (American chameleon), experiment with color change on varying backgrounds. Have children find limit of its ability to blend in with environment. . Look for signs of mimicry in the plant or animal world as evidence of adapting to environment - butterflies, green worms, stick spiders, stripes on zebra, tigers, etc.	*Example: Have tree surgeon and his assistants visit the classroom to demonstrate methods for preserving environmental life. How do insects, drought, imprudent cutting, excessive rainfall affect trees

Objectives	Suggested Activities	Notes
	. Conduct plant experiments to observe adaptation to environment. Turn pots on side, watch bean sprout lean toward source of light as you continually move it further and further away during a span of days. . Bring in some plants from park-land or woods and try growing them in water only. What happens?	
L 1.12 Distinguish between long-term and short-term adaptations.	See Activities under 1.110.	
L 1.13 Select and experiment with changes in the environment of plants and animals to recognize adaptations and their limits.	See Activities under 1.110	
L 1.20 Oxygen and water are essential to most forms of life.		Careers: Biologist Horticulturist
L 1.21 Perform experiments with plants and low forms of animals to realize the importance of oxygen and water to sustain life.	. Put thriving plants in air tight containers. Study effects. . Plant seeds but use no water. . Catch common house-fly and see if it can survive in a sealed jar with water and food but no fresh supply of air.	

Objectives	Suggested Activities	Notes
L 1.30 Most plants need light in order to grow.		Careers: Botanist
L 1.31 Perform experiments with plants to realize the importance of light in promoting growth.	. Put thriving plant in closet in complete darkness to study effect. . Put a thriving plant under a large box with only a small hole at one end or side. Try another with no hole for control. Observe after a period of days. Note difference. . Cover small area of green healthy grass with a board. Uncover after a week or more to observe what has happened. Observe carefully for another week to see what happens and why.	
L 1.40 The position and motion of matter on earth are always affected by the force of gravity.		Careers: Playground director Quarry operator Surveyor
L 1.41 Acquire knowledge about the effects of gravity on the position and motion of matter.	. Collect rocks and place them on a steep incline. Do the rocks stay there or seek a lower level? Which type of rocks might remain where placed? . Use teeter-totter on playground to demonstrate effect of gravity on water. Try to pour water up the board.	

Objectives	Suggested Activities	Notes
	. Follow a stream to see if it runs uphill. . Attach short hose to spigot and force water sideways - does it continue to go this way indefinitely? . Experiment with dry sand and try to heap it as high as you can. What happens? . Try the same experiment (heaping dry sand) with angular stones. Why do they remain heaped up? What property affects the position.	
L 1.50 The earth and other observable bodies in space are approximately spherical.		Careers: Astronomer Audio-visual operator
L 1.51 Classify shapes of objects to become familiar with the term, spherical.	. Use senses of touch and sight to examine properties of spherical objects and others. Classify.	Reference: Science for Kindergarten. SCIS Jan. 74 p.29-49
L 1.52 Infer the shape of objects by considering the form through sense of touch	. Construct a "feely box" and use sense of touch to distinguish shapes. Include several examples of spherical objects.	"P. Mooney Bag" works fine for this project.
L 1.53 Observe shadows cast by spherical objects.	. Use overhead projector to cast shadows of objects for students to infer shapes from visual representation through shadows. . Investigate shadows from objects manipulated in the sunlight.	Resource: What Happens If by Rose Wyler Scholastic p. 33-39

Objectives	Suggested Activities	Notes
L 1.60 The earth and other bodies of the solar system have nearly constant motion.		Careers: Astronomer Photographer
L 1.61 Become familiar with photographs, films, data, about what is known of bodies in space including earth.	. Roleplay position of earth, sun, moon. Use light sources on spherical representations of sun, moon, earth to simulate phases of moon and the shapes that occur.	

ORGANIZATION

Level One (K-2)

Systematic relationships exist in natural phenomena.
Systems within systems comprise the universe.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
Or 1.10 Similar living things tend to live in similar surroundings. Or 1.11 Associate similar living things with similar environmental surroundings.	. Dig in moist, dark places in the woods and find insects and worms. Locate a dead, rotted log, probe through it to look for insects, etc. Call attention to the likeness of the environment and similarities of animal population. . Walk in open field to find what types of plants and animals live there. Compare the field life to that found in most yards. . Visit a small pond and investigate living things found there and compare to living things found in or near stream or creek. . Locate area with stagnant water and look for mosquito larvae. Have students make their own little swamp and observe what kinds of life populate it over a period of time. . Examine a woodland and list the flora and fauna found there. Compare a deciduous wood lot with a coniferous wood lot.	Careers: City Parks and Recreation Dept. worker* Ecologist Entomologist Exterminator Microbiologist Naturalist (field biologist) *Example: 1. Discuss importance of park rules to protect the environment. 2. Have students construct park signs.

Objectives	Suggested Activities	Notes
	. Investigate the environment of man in the city and man in the country. What environmental requirements are the same?	
Or 1.20 The processes by which plants and animals live together can often be inferred from observing their external structures.		Careers: Aviary attendent Environmentalist Fish farmer Marine Studies (U of D)
Or 1.21 Indicate various external structures of plants and animals common to certain groups.	. Have a fish hunt through picture books, films, and live specimens to see how many can be found that have same basic external features: gills, fins.	
Or 1.22 Observe external structures of plants and animals to make inferences about similar and different processes of living things.	. Compare external structures of a variety of plants and/or animals.	
Or 1.30 Most observable substances exist as aggregates of different forms and kinds of matter.		Careers: Cement contractor Potter Rock collector Soil geologist

Objectives	Suggested Activities	Notes
Or 1.31 Examine various substances to distinguish what parts make up the substances.	. Have children examine lumps of clay. Leave on a blotter and notice the ring left after several days.	
Or 1.32 Examine aggregates and try to identify their components.	. Make paper mache objects. Mix sand, cement and water to make concrete.	
	. Use a hand lens to examine sugar, stone, newspaper picture, chalk.	Rockcastle et al, Elementary School Science
Or 1.40 The properties of a material depend on the properties and organization of the different forms of matter that make up that material.		Careers: Chemist Laboratory analyst Laboratory tester
Or 1.41 Investigate and experiment to discover properties of matter.	. Examine salt, sugar, sand, wood, rubber, etc., to determine their properties.	
Or 1.50 The earth, sun and moon have a definite organizational relationship relative to size and distance in space.		Careers: Astronomer Model designer
Or 1.51 Demonstrate by model and diagram the relative size of the sun, earth, and moon.	. Demonstrate with Trippensee planetarium the size comparisons of sun, earth, moon.	
	. Build models to illustrate these comparisons.	

Objectives	Suggested Activities	Notes
Or 1.52 By positioning models illustrate the relative distances of these bodies.	. Trippensee Planetarium demonstrates relative distances of these bodies...which are closer together and which are farthest from earth.	This is an activity for the orientation to the planetarium.
Or 1.60 The earth consists of three parts: a solid part (lithosphere), a part consisting of water (hydrosphere) and a part consisting of air (atmosphere).		Careers: Geologist Meteorologist Miner Oceanographer Oil-drilling engine
Or 1.61 Identify the three main parts of the earth.	. Examine a drawing of a cross-section of the earth and locate the crust, mantle and core of the earth. . Observe the sky. Explain that the atmosphere is an ocean of air surrounding the earth. Observe the effects of moving air.	
Or 1.70 Star Constellations are a guide to finding directions at night.		Careers: Astronomer Navigator Sheep herder
Or 1.71 Locate the Big Dipper and use "Pointer Stars" to establish position of North Star.	. Find position of North Star while facing north, establish south as opposite north to observer; east to observer's right and west to observer's left.	

SCIENCE CURRICULUM GUIDE

LEVEL 2 (3 - 5)

CHANGE

Level Two (3-5)

Our environment, living and non-living microscopic and macroscopic, is constantly undergoing change.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
Ch 2.10 Individual living things are constantly changing.		Careers: Bee keeper Biologist Clothing designer Entomologist Exterminator Food Sales (human and pet) Furniture salesman Governmental Services Schools Social Security Child Labor Laws Health Services Child care Care for the Aged Disease control Pet shop operator
Ch 2.11 By observation of individual living things, recognize changes due to growth, aging, season and environment.	. Maintain and observe classroom pets, e.g., insects (ants, bees, beetles, flies, moths, butterflies, etc.) worms, snails, crabs, frogs, toads, fish, hamster, gerbils, mice, guinea pigs, etc., particularly noting occurrence of changes. . Report changes in personal and family pets since acquisition. . Bring in pictures of living things as the elements of "Scrap Book of Seasons" or a "Scrap Book of Growth."	
Ch 2.20 Species are constantly changing.	. In the fall, bring in some green leaves and leaves that have changed color. (from the same tree) . Bring in family photos, baby, 1st grade...Note changes in growth (i.e. hair, height, weight, etc.) . Discuss the loss of teeth due to growth. (deciduous teeth)	Careers: Archaeologist Epidemiologist Food grower Geologist Historian Paleontologist Seed supplier Zoo keeper

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
Ch2.21 Identify evolutionary changes indicated by historic and geologic evidence.	. Select different species, research the evolution and prepare a report for presentation to the class, indicating significant changes, inferring causes. . Investigate disease and pest control particularly noting the development of antibiotic and pesticide resistant species.	Careers cont'd.: Communications Public health nurse Vaccine manufacturer
Ch2.30 Population compositions and densities are constantly changing.		
Ch2.31 In a given population the pupil will observe environment, infer past composition and density, and predict future composition and density.	. Maintain and observe a group of living things in the classroom, e.g ants, guppies, snails, algae. . Locate a colony on the schoolground and observe changes that occur during the school year, e.g. grass plot, ant hill, beehives,etc. . Establish a closed biosphere, observe changes, infer causes, predict future composition.	Careers: Bee keeper Exterminator Food store worker Gardner Grounds keeper Highway patrol person Hospital worker Newspaper employee Pollution control technologist Trucker Water company employee
Ch2.40 Consumption, source, and nature of resources are constantly changing.		Careers: Demurrage clerk (RR and trucking) Farm hand Farm operator Seed company employee Tractor salesperson

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
Ch 2.41 Given a resource the pupil will identify its source, refinement, consumption, historic background and probable future.	. Research different phases of a particular resource, e.g., source, refinement, consumption, historic background , and probable future. Some oil companies will give slide presentations. (Gulf Oil Company will give slide presentation at the school) . Research the changes in resources used for a particular purpose, e.g. household heating, production of electricty, transportation, clothing, food, packaging, construction.	Careers cont'd.: Appliance salesperson Bureau of Mines employee Clothing manufacturer Fuel oil delivery person Gas station worker Miner Pollution control tech. Power company employee Prospector Recreational employee
Ch 2.50 Land, water, and land mass distribution are constantly changing.		
Ch 2.51 By observation of a given land area identify changes due to the biotic community and atmospheric condition.	. Select a particular land area (preferably on the school ground) inventory its condition and biotic community. At specific intervals reinventory your "claim" noting changes and inferring causes of change. Take a field trip to state parks to note succession. . Identify areas on the school ground which exhibit "good" or "bad" examples of changes due to atmospheric conditions and/or biotic communities.	Careers: Builder Cartographer Geographer Grave stone and monument engraver Highway constructor Laboratory technician Land use planner Miner Nuclear physicist Oceanographer Paleontologist Public health nurse Surveyor Water works worker

Objectives	Suggested Activities	Notes
Ch 2.52 By observation of a given land area infer past geologic changes.	. Show films of volcanic areas, mountains, canyons, etc. Look at pictures of each and note changes.	
Ch 2.53 Identify changes occurring in a given sample of water.	. Collect three jars of water, one tap water; one, pond stream or puddle water with mud and vegetation; one, clear pond, stream or puddle water. Have students observe sample (by naked eye, magnifying glass and microscope) noting changes as they occur.	
Ch 2.54 Identify the composition of a given body of water, infer history, and predict future.	. Identify primary characteristics of several different types of bodies of water (e.g., pond, lake, stream, river, bay, gulf, ocean) infer history and predict future. . Investigate the increasing accuracy of the measurement of the ocean resulting from the "space age" technology. (i.e. satellite pic.)	
Ch 2.55 Identify evidence of continental shifting (global tectonics.)	. Investigate earthquake and volcanic activity on a global basis, noting patterns (e.g. use maps to locate the "Ring of Fire.") . Investigate characteristics and significance of ocean floor structures. Make a model of a portion of the ocean floor. Identify the structures (e.g. National Geographic.)	

Objectives	Suggested Activities	NOTES
Ch 2.60 The condition and composition of the atmosphere are constantly changing.		Careers: Central heating and air conditioning installer Clothing designer Communications worker Emergency workers Farmer Fuel supply demand clerk Newspaper delivery person Pollution control technologist Railroad worker Restaurant and recreational area employee Store clerk Student Trucker Weather forecaster
Ch 2.61 Distinguish between weather and climate and indicate evidence of change in both.	. Describe the weather on a particular day and analyze its elements . Record the daily weather for a month, particularly noting recurring patterns of change (i.e., use weather symbols on a large calendar poster. Graph the results using a bar or line graph.) . Identify local ranges and records for the elements of the weather. . Pick a place and compare its ranges and records with local ranges and records. . Identify record-holding hot, cold, dry, wet areas. Plot these locations on a large world map. . Check newspaper for national high and low temperatures for each day in a week (i.e., plot these locations on a U.S. map)	
Ch 2.62 Identify composition of the atmosphere, infer past composition, indicate possible future composition.	. Identify the current composition of the atmosphere (e.g., draw a pie graph and denote percentages) . Identify sources of components of the atmosphere (e.g., oxygen-plant life) . Infer changes in the sources of components of the atmosphere, citing geologic evidence.	

Objectives	Suggested Activities	Notes
	. Infer changes in the current composition of the atmosphere as a result of analysis of the sources of its components.	
Ch 2.70 Planets travel in fixed orbits about the sun and are continuously changing their positions as viewed against the background of stars.		Careers: Astronomer Cartographer Navigator Photographer "Sky and Telescope" magazine employee Telescope and binocular salesperson
Ch 2.71 Over a period of time pupils will observe that the planets have changed their positions.	. Keep a sky map charting the movement of the planets over a period of several weeks	Sky Photography is an excellent activity to map the movement of the planets.
Ch 2.80 An Eclipse of the sun occurs when the moon passes between the earth and the sun cutting off the light of the sun from a portion of the earth.		Careers: Astronomer Planetarium builder Planetarium designer Planetarium maintenance and repairperson Planetarium operator Planetarium salesperson Projectionist Radio technician
Ch 2.81 Pupils will observe and be able to diagram effects of a sun eclipse in progress as observed from the earth.	. Study pictures and diagrams of sun eclipse both total and partial and explain the causes. Draw pictures of each labeling the sun, earth, and moon.	

Objectives	Suggested Activities	Notes
	. Demonstrate total sun eclipse in planetarium by use of extra effects projector and rotating disk simulating the eclipse as it appears from a point of totality on earth. . Investigate historic explanations of the effect of eclipses.	
Ch 2.90 Moon eclipse occurs when the moon passes through the shadow of the earth.		
Ch 2.91 Pupils will be able to make diagrams illustrating causes of moon eclipse.	. Build models of earth, sun, moon relationships to demonstrate the cause of eclipse of both the sun and the moon.	Careers: Astronomer Designer Draftsperson Model builder
Ch 2.90A The relative positions of celestial bodies are constantly changing.		Careers: Astronomer Outside night worker
Ch 2.91A By observation of seasonal changes, apparent migratory nature of planets (and other celestial phenomena) infer the change of the relative positions of elements of the solar system, galaxy and universe.	. Observe a particular area of the sky at a particular time of the day noting the position of any celestial bodies observable at that time for a given period (week or month) noting changes. . Investigate historical celestial changes (constellations, pole star) and predicted changes.	Coincide with planetarium visits

Objectives	Suggested Activities	Notes
	. Investigate the astronomic significance of Stonehenge, Egyptian and Mayan Pyramids, (loss of the superstition) Mt. Treasure, and the development of calendars.	
Ch 2.90B Constellations are important guidelines useful in finding directions and in studying daily and annual changes.		Careers Astronomer Hunting & Fishing Guide Nature Instructor Navigator
Ch 2.91B By following the "apparent motion" of the circum-polar constella-tions observe the relative movement of earth's rotation.	. Mark the relative position of the Big Dipper at one hour intervals for a period of several hours. . Compare the "apparent motion" of the dippers with the movement of Cassiopiea, the Queen.	
Ch 2.92B Differentiate between the apparent motion of circumpolar constellations as compared to the motion of seasonal constellations.	. Use planetarium daily motion to demonstrate the circulation of Northern constellations about the North Pole Star.	
Ch 2.90C The earth's magnetic field is in constant flux.		Careers: Archeologist Communications supervisor Geophysicist Radio technician

Objectives	Suggested Activities	Notes
Ch 2.91C Infer the magnetic significance of the Atlantic corings by the "Glomar Challenger."	. Define earth's magnetic field and compare to a magnet using iron filings on paper. . From the magnetic patterns of the Atlantic floor as established by the Glomar Challenger corings, infer past changes in the earth's magnetic field and predict future changes. . Discuss possible impact and imminence of the magnetic reversals. . Investigate the effects of magnetic reversals on climate.	
Ch 2.90D The time interval of change varies and many changes are cyclic.		Careers: Archaeologist Geologist Land use planners Law enforcement officers Paleontologist Rescue workers
Ch 2.91D From a given group of changes classify those of a cyclic nature, short and long range interval.	. Prepare a list of changes observed classifying the list on a basis of time interval and recurrence. . Illustrate a change not observed but supported by evidence, (sift sandy soil for shells, observe strata, examine rocks.) . Develop models to illustrate crustal change, (faulting, folding, volcanic activity.)	

Objectives	Suggested Activities	Notes
	. Compare growth records of a group of humans, infer "normal" range, plateaus of growth and adult size.	
Co 2.30 There is a constancy in energy levels, energy exchanges, and energy transmission.		Careers: Laborer Mechanical engineer Oilburner service person Physicist Public health doctor Red Cross worker Refrigeration repair person Utility worker
Co 2.31 Experimentally establish response to environment and environmental changes.	. By varying planting mediums and environmental conditions, observe growth and similarities and differences, infer the factors of food production in plants.	
	. After establishing the existence of food chains and/or nets, predict the impact of environmental change. Include unusual meteorological events as well as seasonal and long term changes.	
	. Define and develop some simple machines and investigate their utility through experimentation.	
Co 2.32 Collect data on the forms and transformation of energy, inferring the continuity in energy levels, exchanges and transmission (also relate to eteorology).	. By measurement establish the work input of a variety of simple machines and, by prediction and measurement, the work output.	
	. By experiment and vector analysis, establish the forces involved in static situations and changes resulting from the introduction of new forces.	
	. Develop experiments illustrating basic properties of a variety of forms of energy (heat, light, electricity, magnetism, etc.)	

Objectives	Suggested Activities	Notes
	. Through schematic illustrations demonstrate the source of energy causing meteorological changes at planetary, seasonal, and local level. . By analysis of student records, infer the regularity and range of change in the local weather. Verify results with the Weather Bureau.	
Co 2.40 There is a constancy in celestial motion.		Careers: Almanac editor Aquaculturalist Cartographer Fisherman Lifeguard Sailor Weather person
Co 2.41 Observe and collect data on celestial motion, infer effect on the earth and predict future positions.	. Coordinated with planetarium visit, prepare sky maps of the stars and planets at sufficient intervals to establish positional change (apparent) resulting from both daily and annual motion of the earth and planets. . Through study of sketches resulting from observation of the moon, infer the continuity of the moon's phases. . From a chart of collected data, predict the time of sunrise and sunset. . Establish tidal relationship to position of sun, moon, and earth.	

Objectives	Suggested Activities	Notes
Co 2.50 Seasons of the earth are caused by a tilting of the earth's axis as it travels around the sun.		Careers: Astronomer Farmer Planetarium operator Resort owner
Co 2.51 The apparent position of the sun in the sky at noon varies seasonally.	. Establish the location of the sun at noon for a given period, noting changes. . Mark with shadow sticks the length of noon shadows for several weeks in succession to note change in sun position at noon. Show this also in planetarium demonstration.	
Co 2.52 Over a period of weeks, observe the change in rising and setting positions of the sun in relation to direct east-west position on horizon.	. With planetarium use of daily and and annual motion synchronization show that the sun rises farther and farther south of east when approaching winter solstice, and farther north of east with approach of summer solstice.	

DIVERSITY

Level Two (3-5)

The vast number of natural phenomenon which can be observed display a wide variety of similarities and differences.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
D 2.10 Natural phenomena display a wide variety of similarities and differences. D 2.11 Given examples of natural phenomena, describe similarities and differences.	. Choose two students and describe similarities and differences between them. . Using hula-hoop, wire coat hanger, or other means of delineating an area, note the organic population and physical environment. . Identify and compare the trees and shrubs on (and adjacent to) the school property. . Collect, observe and classify common seeds. . Identify methods of seed dispersal. . Examine and identify buds of plants on the school property. . Identify plants belonging to the four phyla (Thallophyt , Bryophyta, Pteridophyta, and Spermatophyta) and discuss structural differences. . Bring into class and describe the characteristics, care, and feeding of pets.	. Careers: Agricultural researcher Astronomer Biologist Botanist Designer Ecologist Geologist Horticulturist Photographer Pilot Weather forecaster

Objectives	Suggested Activities	Notes
	. Maintain a balanced classroom aquarium and report similarities and differences in the living things in the aquarium. . Identify and describe local geologic structures. . Design and fabricate models of structures. . Bring in stones and, in small groups, brainstorm methods of examining and measuring characteristics of the specimen. Classify them in different ways. . Discuss the weather and its components. Compare and contrast to climate. . Collect storm pictures and articles for display for bulletin boards and scrapbooks. Classify by type (i.e.wind, rain, etc.). Discuss similarities and differences. . Identify the kinds and altitudes of clouds both real and pictured. (e.g. Develop models of clouds and label each using cotton on paper.) . Observe a quadrant of the night sky and identify constellations. . Make transparencies or slides of the constellations. . Discuss the similarities and differences of objects observed.	Plan and schedule study of astronomy to coincide with trip to the planetarium.

Objectives	Suggested Activities	Notes
	. Make mobiles, models, charts, of the solar system identifying the units.	
D 2.20 Living things respond to an environmental change by adaptation, egress or death.		Careers: Cannery worker Entomologist Exterminator Fish and game warden Food processing plant worker Landscape gardner
D 2.21 Given a group of living things, indicate the way each has adapted to its particular environment, migrated from a hostile environment, or died as a result of lack of adaptation.	. Maintain a terrarium of a specific nature (bog, woodland, sandy). Record observed adaptations of living things. . Collect and maintain insects, noting adaptation to a particular environment. . Bring in pictures of animals to be used to identify adaptations and to make a scrap book or display representing the animal phyla. . Compare inherent survival tactics of a variety of animals. . Maintain earthworms. Study response to environmental conditions. . Raise brine shrimp, noting optimum conditions for hatching and growth. . Identify or classify the organisms in a sample of water. Seal the container and examine it periodically to see if changes in the populations occur.	

Objectives	Suggested Activities	Notes
D 2 22 Identify ways in which man has adapted to different environments.	. Show pictures of men living in different environments; discuss physical and cultural adaptations to particular environments. . Discuss life support systems for space flights, high altitudes, and under water environments.	
D 2.30 Inorganic matter responds to environmental change by change of state, structure or energy level.		Careers: Accoustic engineer Airplane pilot and/or navigator Custodian Electrician Geologist Land use planner Musician Photographer Plumber Projectionist Rock hound Spectro-analyst Zoning board member
D 2.31 From a list of environmental changes, identify those causing a change of state, structure, or energy level of particular inorganic materials.	. Describe and demonstrate sources of energy. Discuss kinds and transformation. . Fabricate devices to transform electric energy into other forms of energy (i.e., light circuits motors, heating elements). . Identify the reflection, absorption, transmission of light by substances. . Identify opaque, translucent, and transparent substances. . Examine the effect of parallel flat surfaces, non-parallel flat surfaces, and curved surfaces, on the transmission of light by transparent substances. (Observe pencil in a glass of water) . Examine the effect of reflection by flat and curved mirrors. (e.g. Discuss distorted mirrors at carnivals)	

Objectives	Suggested Activities	Notes
	. Examine multiple image formation with flat mirrors. . Identify the characteristics of sound (volume, frequency, overtones). . Demonstrate the transmission of sound by a variety of substances (i.e. ruler, chalkboard, linoleum). . Demonstrate the effect of a column of vibrating air on the sound produced. . Vary tension, length, and size of vibrating strings or rubber bands noting differences in the characteristics of the sound produced. Demonstrate with a stringed instrument. . Design, fabricate, and demonstrate musical instruments and/or noise makers, and stage a concert. . Identify probable structural sources and causes of changes in rock specimens. . Duplicate weathering processes. . Identify the cause of latitudinal differences in weather. . Identify planetary air movements and the cause of local differences. Discuss land and sea breezes, ocean currents and mountain deflection.	

Objectives	Suggested Activities	Notes
	. Predict weather on a basis of local conditions, recording reason and prediction. Compare predictions with actual weather.	
D 2.40 Man, in adapting to and in adaptation of, his environment, has developed tools extending the range and provision of his senses facilitating better understanding of his dependence on the environment.		Careers: Astronaut Auto repair person Carpenter Hardware salesperson Machine salesperson Machinist Microbiologist Oceanographer Optician Plumber Radar operator Tool maker
D 2.41 Identify tools developed by man to extend the range and precision of his senses.	. Use hand lens, microscope, telescope, sound amplifiers, measuring devices.	
D 2.42 Given a list of tools, describe ways the tools have been used to adapt the environment to man.	. Bring in pictures of tools (machines) and classify by use to extend man's senses or modify environment. Design a tool showing adaptation to a particular environment. (e.g. handling of radioactive material)	
D 2.50 Planets visible from earth in the morning and evening skies are called "Morning and Evening Stars."		Careers: Astronomer
D 2.51 Recognize planets as opposed to stars by observing their positions relative to the star background.	. In the evening sky, observe that "Evening Star" planets appear in the sky before stars appear., and often, they are brighter than stars because of their proximity to the earth.	

Objectives	Suggested Activities	Notes
D 2.60 The solar system consists of the sun, planets, moons (or satellites) asteroids, meteors and comets.		Careers: Aerospace company worker Astronaut Astronomer Space vehicle designer
D 2.61 List the planets in their order from the sun.	. Build or use model of planets based on relative size and relative distance from the sun. . Use planetarium orrery to demonstrate size-distance relationships of sun and planets.	
D 2.62 Describe the similarities and differences in meteors, moons, comets and asteroids.	. Prepare reports on similarities and differences of meteors, moons, comets, and asteroids. Draw pictures and label. . Identify and illustrate similarities and differences in parts of the solar system using slides, filmstrips and/or pictures.	

INTERACTION

Level Two (3-5)

The interactions of living and non-living matter in an environment and the resulting exchange of energy determine the nature of the environment.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
I 2.10 The presence of living material is an effective factor of the environment.		Careers: Agricultural Inspector Cafeteria manager Customs official Fish and Game warden Florist Health worker Home owner Naturalist Park manager Sanitation worker World food and agriculture organization
I 2.11 Recognize living material as both consumer and producer.	. Develop a list of common organisms and survey the consumer role of each in relation to the environment. . Survey the producer role of each organism in preceeding list . Observe the effects resulting from the consumer/producer role of organisms in the environment (school, home, district trips, i.e., White Clay Creek State Park.)	
I 2.12 Be aware that the environmental impact of two organisms may be mutually detrimental, or beneficial to one and detrimental to the other, or beneficial to both.	. Observe the symbioses in lichens. . Explore man's dependence on other living organisms (source of food, oxygen). . Investigate the impact of selected organisms on man (parasites, disease causing microorganisms).	

Objectives	Suggested Activities	Notes
I 2.13 Observe that the biologic balance in a community can be shifted by the introduction of new species and/or a change in the non-living environment.	. Research the background of alien organisms, (i.e., sparrows, starlings, Japanese beetles box-wood, Japanese red maple). . Research recent threats resulting from migration, natural and/or artificial, of harmful organisms (fire ants, African bee, Clarias catfish, disease-causing organisms, locusts). . Observe phototropic response to "alley of light" (roads, stream) by flora (particularly at Rittenhouse Park). . Establish population of progressive communities under various conditions (contained pond water).	
I 2.14 Understand that competition for dominance results in a stable climax community.	. Observe interface of two communities and establish the direction of infringement on the biologic community.	
I 2.20 Existing conditions determine the physical state of material.		Careers: Container manufacturer Engineer Foundry worker Ice cream salesperson Physicist Plumber

Objectives	Suggested Activities	Notes
I 2.21 Recognize that energy levels determine the physical state of materials.	. By experiment establish the point of change of state of a variety of materials (water, carbonated water).	
I 2.30 Temporal interval of change of conditions affects the structure of materials.		Careers: Chemist Geologist Laser manufacturer Prospector Rock hound
I 2.31 Observe that the rate of change in energy levels affects the structure of materials.	. Grow crystals, recording the temporal interval, inferring the conditions involved in the formation of a variety of granites, pegmatites, quartz specimens.	
I 2.40 Matter attracts matter.		Careers: Central heating installer, maintenance person Civil engineer Heat engineer Physicist
I 2.41 Be aware that the gravitational attraction for matter may be supplemented by electrostatic or magnetic fields.	. Differentiate between mass and weight. Relate "mass" to the measurement of gravitational forces. . Create discrepencies or deviation in the measurement of gravitational forces by the introduction of electrostatic and/or magnetic fields.	
I 2.42 Observe that change in energy levels affects gravitational forces.	. Relate density to heat levels and gravitational attraction to density. Explore the relationships of density and convection currents. . Investigate convection currents in gases, liquids, and evidence of their existence in the various levels of the earth.	

LIMITATION

Level Two (3-5)

Natural phenomena are limited by the fundamental nature of matter and energy. There is an overall tendency toward random distribution of energy and a corresponding tendency toward equilibrium in an environment.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
L 2.10 The world and its resources are finite.		Careers: Aerial photographer Airline employee Architect Consumer Manufacturer Plant manager Railroad worker Space scientist Supplier Trucker
L 2.11 Establish the finite nature of the earth.	. Investigate earth's measurements and pictures taken from space inferring earth's finite nature.	
L 2.12 Establish a definition of resource and identify limiting factors.	. Through discussion and investigation of historic material, identify a variety of resources, evolve a definition for the word resource, and infer the limiting factors involved.	
L 2.20 Energy naturally tends towards stasis. The available energy in a given area is limited.		Careers: Ecologist Electrical engineer Energy research worker Generating plant worker Home owner Meteorologist Utilities plant designe
L 2.21 Observe and measure some of the effects of the natural tendency of energy to redistribute equally.	. Establish effects of the natural redistribution of energy in the lithosphere, hydrosphere, and atmosphere.	

Objectives	Suggested Activities	Notes
L 2.22 Survey available forms of energy in a given area and infer limiting factors.	. Establish available sources of energy (i.e., wind, solar, hydro-electric, geothermal, tidal, etc.) and their limiting factors.	
L 2.30 Living things compete for available resources and tend toward a balanced terminal community.		Careers: Agricultural technologist Community planner Forest ranger Park manager
L 2.31 Identify evidence of competition among living things for available resources, including man's competition for energy.	. Identify phototropic responses in plant life. . Identify agricultural pest and weed control as man in competition for energy.	
L 2.40 Adaptability is only effective within a range of conditions and at a limited rate of change. Man modifies conditions to keep them within the range of his tolerance.		Careers: Auto designer Builder Car salesperson Clothing designer Dry goods clerk Environmental engineer Paleontologist Real estate salesperson
L 2.41 Collect data on the nature of adaptations, and the time interval involved in these adaptations.	. Collect paleontological evidence of extinction and adaptation as a result of environmental changes.	

Objectives	Suggested Activities	Notes
L 2.42 Identify a variety of ways that man modifies the environment to which he is exposed.	. Identify methods of environmental control employed by man in the form of clothing, habitation, and transportation.	
L 2.50 The impact of man has changed, and is changing the environment beyond the range of adaptability of other living things (and possibly of man, himself!)		Careers: Cesspool and septic tank cleaner City planner Civil engineer Custodian Ecologist Garbage person Sanitary engineer
L 2.51 Investigate man's impact on the environment.	. Research man's impact on the environment particularly the short and long term impact of waste disposal, pesticide use, change of permeability of surface, land use, etc. . Research the children's impact on the school building and grounds.	
L 2.60 Physical changes are dependent on energy levels.		Careers: Freezer designer Thermal engineer
L 2.61 Investigate the changes in energy level involved in a change of physical state.	. Investigate energy relations in the change of physical state of water. . Demonstrate that pressure changes the phase of matter. Suspend two weights on a piece of wire over an ice cube. Observe how the pressure changes a solid to a liquid.	

Objectives	Suggested Activities	Notes
L 2.70 The rate of mutation is influenced by a variety of conditions. The survival and reproductive rate of mutants is low.		Careers: Aquarist Paleontologist Parent Research botanist Research zoologist Seed producer
L 2.71 Identify some factors affecting the rate of mutation.	. Identify paleontologic evidence of the dramatic change in species and/or appearance of new species. Show and discuss pictures of the new species emphasizing the adaptation characteristics.	
L 2.80 Hybridization occurs between compatible species.		Careers: Farmer Gardener Horticultural supply worker Landscape Designer Research botanist Research zoologist
L 2.81 Collect and interpret data on artificial hybridization.	. Investigate seed production both for commercial and research purposes.	
L 2.90 The existence of some planets was first established by calculation of velocity and gravitational effects on orbits of known planets.		Careers: Astronomer Mathematician
L 2.91 Investigate the discovery of the outer planets.	. Investigate the historic material available concerning the discovery of the outer planets.	

Objectives	Suggested Activities	Notes
L 2.90A Time on the earth is measured by the earth's rotation. L 2.91A Explain time on the earth by the use of a model.	. Use world globe and light source (representing the sun) to demonstrate time zones. Calculate dates and times in different locations around the world. . Make a flat map representation of these time zones. . Make a round ball or "grapefruit" model of earth time zones.	Careers: Airline personnel Clock maker Long distance telephone operator Navigator Short wave radio listen Transoceanic shipping personnel

Systematic relationship exists in natural phenomena. Systems within systems comprise the universe.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
Or 2.10 The cell is basic to living things; these living things vary in their degree of complexity (specialization).		Careers: Cytologist Doctor Exterminator Microbiologist
Or 2.11 Observe the cellular structure of a variety of living material.	. Assemble the necessary equipment and specimens to observe both plant and animal cells. Graphically reproduce the observations. Note cell wall and presence of chlorophyll in most plant life.	
Or 2.12 Survey a variety of plants and animals noting their degree of complexity.	. Through direct observation and/or research of printed material, identify the varying degree of complexity of living things.	
Or 2.20 Organized classification is based on similarities and differences.		Careers: Biologist Botanist Zookeeper Florist Pet Shop Owner
Or 2.21 Recognize the broad basis of classification of the plant and animal kingdom.	. Assemble material representing specimens of each of the plant and animal phyla.	

Objectives	Suggested Activities	Notes
Or 2.30 Groups of living things exist in areas with similar conditions (biomes, ecosystems.) An interdependence exists among these living things. The greatest variety of life forms exist at the interface of environmental areas. Living things respond to a change in environment in three ways - adapt, migrate, or die.		Careers: Agricultural agent Architect Builder Ecologist Farmer Forest ranger Land use planner Landfill operator Wildlife manager
Or 2.31 Identify a variety of living things in a variety of biomes or ecosystems.	. Create a model or graphic representation of a given biome indicating the living things there and the adaptation of each to specific factors of that particular biome.	
Or 2.32 Observe direct interdependence among living things in a given biome.	. Identify food chains and/or webs, and elemental cycles in living areas. (Draw pictures of a food chain.)	
Or 2.33 Observe the adaptation of similar living things to different environments.	. Collect and explain evidence of living things that no longer exist in a given area and evidence of environmental changes in the area.	

Objectives	Suggested Activities	Notes
Or 2.34 Establish evidence of the migration or extinction of life forms as a result of a change of environment.	. Investigate the effects of introducing DDT into the environment.	
Or 2.35 Compare the life forms present in a variety of environmental areas and at the interface of these areas.	. Given a specific environmental interface identify life forms present.	
Or 2.40 Man's manipulation and impact on living conditions necessitates a positive land use policy.		Careers: City planner Consumer Pollution controller Water analyst
Or 2.41 Identify a variety of deletorious impacts of man and/or his activities in terms of the interdependence of living things.	. Identify land that has become non-productive as a result of a change in land use by man (developments, shopping centers, etc.) . Identify some of the impacts of man and his by-products on the lithosphere, hydrosphere, and atmosphere (e.g. depletion of fossil fuels, use of pesticides and herbicides, depletion of mineral resources, etc.)	
Or 2.50 Energies, forces, and motions can be described in terms of measurement of their effects.		Careers: Insulation engineer Lighting engineer Meter reader Oven and stove designer Pile driver Riveter

Objectives	Suggested Activities	Notes
Or 2.51 Measure the effects of a variety of energies, forces, and motions.	. Measure the effects of heat, light, sound, magnetism, motion, inertia, electric current, describing each in terms of the measurement.	Careers (cont.): Accoustic designer Fireman Heat treater Safety personnel Transportation person
Or 2.60 Many complex machines are a combination of simple machines. Input and output in simple machines are equal.		Careers: Crane operator Drill press operator Machine operator Mechanic Processor
Or 2.61 Measure and mathematically describe the input and output of the six simple machines, and recognize their use in more complex machines	. Determine mechanical advantage of six different simple machines and measure the output resulting from a given input.	
Or 2.70 Many materials are described in terms of the level of their ability to transmit, absorb, or reflect various forms of energy.		Careers: Architect Builder Electrician Junk yard operator Scrap buyer Telephone engineer Window designer
Or 2.71 Describe a variety of materials in terms of the degree of their transmission, absorption or reflection of electricity, magnetism, heat, light, sound.	. Demonstrate conductors and insulators of heat and electricity. . Separate magnetic substances from non-magnetic substances.	

Objectives	Suggested Activities	Notes
	. Identify transparent, selectively transparent, translucent, reflective, selectively reflective and opaque materials. . Identify materials that absorb, transmit and reflect sound.	
Or 2.80 Geologic activity can be inferred from existing structures and materials.		Careers: Architect Building code writers Building inspectors Dam builders Earth mover operators Geologist Land use planner Volcanologist
Or 2.81 Recognize a variety of geologic structures and materials and infer the geologic activity of their formation.	. Separate a variety of igneous, metamorphic, and sedimentary materials. . Differentiate volcanically and diastrophically formed mountains. . Identify currently active geologic forces (erosion, deposition, uplift, faults, plate shift.)	
Or 2.90 Specific crystalline structures are formed by specific materials under specific conditions.		Careers: Diamond cutter Jeweler Laser builders Prospectors Watch makers
Or 2.91 Identify the crystalline structure of a variety of materials.	. Given a variety of substances graphically represent the crystalline structure of each (salt, sugar, sulfur, lead, etc.) . Grow a variety of crystals.	

APPENDICES

APPENDIX I

RECOMMENDED TIME ALLOTMENT FOR SCIENCE

At the kindergarten level it is recommended that the teacher spend a minimum of 20 minutes three days a week exploring natural science with the students.

At the first grade level it is recommended that the teacher spend a minimum of 20 minutes five days a week exploring natural science with the students.

At the 2nd, 3rd, and 4th grade teaching level it is recommended that the teacher spend a minimum of 30 minutes a day five days a week exploring natural sciences with the students.

At the junicr high and/or middle school level, (grades 5 to 8) it is recommended that the teacher spend a minimum of 40 minutes a day five days a week exploring natural science with the students.

Instructional time spent in related areas of natural science such as health, drug, sex and/or emergency preparedness is not part of this basic time allotment.

This time allotment complies with the suggested time allotments adopted by the Delaware State Board of Education on May 15, 1969.

APPENDIX II

SCIENCE COURSES[1]

1. CONCEPTUALLY ORIENTED PROGRAM IN ELEMENTARY SCIENCE (COPES). 1972-1973. Morris H. Shamos, Department of Physics, New York University, 4 Washington Place, New York, New York 10003.

   Digest. COPES is a science program for students in grades K-6. The curriculum materials developed by the project consist, in the main, of teacher guides that provide understanding of the science involved and permit teachers to guide pupils through the student-oriented activities.

2. ELEMENTARY SCIENCE STUDY (ESS). 1962-1973. Joseph Griffith, Education Development Center, Inc., 55 Chapel Street, Newton, Massachusetts 02160.

   Digest. The Elementary Science Study project developed 56 units for use in science programs from kindergarten through the 8th grade. Each unit is designed to be used over a range of grade levels, depending on the scope and depth of the approach. ESS units do not comprise an elementary school science curriculum. Rather, teachers may select from them to construct a course to meet local needs or to supplement existing courses. Their adaptability enables use in conventional or "open" classroom settings.

3. SCIENCE CURRICULUM IMPROVEMENT STUDY (SCIS). 1962- . Robert Karplus, Lawrence Hall of Science, University of California, Berkeley, California 94720.

   Digest. The SCIS project has developed ungraded sequential physical and life science programs for the elementary school that are designed to turn the classroom into a library.

4. SCIENCE - A PROCESS APPROACH (SAPA): COMMISSION ON SCIENCE EDUCATION. 1962-1971. John R. Mayor, American Association for the Advancement of Science, 1515 Massachusetts Avenue, N.W., Washington, D.C. 20005.

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[1]National Science Foundation, Course and Curriculum Improvement Projects, 1974, p. 6-8.

Digest. Science - A Process Approach is an elementary school science curriculum for use in kindergarten through grade 6. Topics covered in the exercises sample widely from the various fields of science. Mathematics topics are included, to be used when needed as preparation for other science activities. The program has a sequential pattern to provide a developmental progression of increasing competence in the processes of science.

5. ELEMENTARY SCHOOL SCIENCE PROJECT (ESSP). 1960-1969. J. Myron Atkin, Department of Elementary Education, and Stanley P. Wyatt, Jr., Department of Astronomy, University of Illinois, Urbana, Illinois 61801.

Digest. The project staff, made up of professional astronomers, science education specialists, and classroom teachers, identified and developed certain major conceptual themes in astronomy appropriate for upper elementary and junior high school students. Materials were revised on the basis of findings from extensive field tests and other evaluation activities. The final product is a series of six books, each accompanied by a teacher guide.

APPENDIX III

GENERAL GOALS OF A CAREER-SCIENCE CURRICULUM[1]

A. To instill in students an awareness of the broad range of careers available to them.

B. To integrate career information, and broaden the horizon of students as they learn to understand and use scientific processes in problem solving, and decision making.

C. To make obvious the value of science in student's career and educational planning.

D. To show students that there are respected vocations available for all ranges of intellectual and manual talent.

E. To provide student with better techniques to understand himself, his interests, talents and abilities, and how they fit his career potential.

F. To help develop an intrinsic motivation within the students for understanding science and perceiving the value of the science curriculum.

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[1] Science Unit (Career Related), Minnesota State Department of Instruction, Vocational-Technical Division.

APPENDIX IV

NON-SCIENCE THEORY IN SCIENCE INSTRUCTION[1]

Throughout his recorded history, man has been vitally concerned to find out all that he can about his universe. He has explored it in many ways, raised questions about it, designed methods by which he could increase and organize his knowledge, and developed systems to aid him in understanding and explaining his own origin and nature and his place in the universe. Among these systems are philosophy, religions, folklore, the arts, and science.

Science is the system of knowing about the universe through data collected by observation and controlled experimentation. As data are collected, theories are advanced to explain and account for what has been observed. The true test of a theory valid in science is three fold: (1) its ability to explain what has been observed: (2) its ability to predict what has not yet been observed; and (3) its ability to be tested by further experimentation and to be modified as required by the acquisition of new data.

[1]Delaware State Department of Public Instruction, Equinox, A model for the natural science education curriculum for the second, third and fourth grades in the Delaware Schools, August 14, 1973.

APPENDIX V

READING FOR SCIENCE

One of the common excuses for not completing the expected work in science is that the children can't read. For this reason there are occasions when time which normally should be allotted to science instruction is used instead for reading. There are two possible solutions to this problem, neither to be considered alone:

1. Incorporate science material into the reading program;
2. Develop skills in reading science literature.

To incorporate science material into the reading program, the resources of the Instructional Materials Center become essential. A wide variety of interesting science-related books and magazines are on the market. If the reading needs of the science student are to be met, a well-stocked science section is a necessity in the IMC.

To develop skills in reading science literature there are several approaches that have proved to be effective. Since the science curriculum is activity-oriented, there are many examples of student involvement which will lead toward goal-attainment without relying on reading skills which may be missing or very weak. Science lends itself readily to the language experience approach used in the elementary school in which children dictate a story, or sequence science-related activities, and then read or

have this narrative read back to them. This practice helps to develop the key skills of comprehension in the elementary student. Skills that may be sharpened by this method include:

- the ability to draw conclusions;
- an understanding of the cause and effect relationship;
- the ability to detect sequences;
- competence in finding the facts;
- proficiency in getting the main idea.

At the middle school level the language experience approach can be used with the content of science by having the student dictate his own textbook. The information could be written on the board and then duplicated for class use.

A technique long proved effective in reading for meaning and understanding is the PQRST approach, a method attributed to the Air Force Academy:

Preview
Question
Read
Study
Test (formal testing or test yourself)

An explanation of these steps follows:

Preview

- Read the bold-face type
- Observe the pictures
- Read the captions
- Read the general questions at the end of the chapter
- If there is a glossary, study this.

Question

- Consider the items that are in bold face type and turn them into questions.

Read

- Keep the questions in mind, as well as the survey items, and then read the assignment.

Preview

- Answer the questions; these can be student or teacher originated.

Recite

- Communicate to someone in some way the information that has been gained. For the problem readers, this can be done orally. Others may wish to write their summaries. This communication may start with a structured question.

Most important of all, if a teacher makes a reading assignment, some time should be spent to prepare the student to read this assignment. This preparation should include a review of the essential vocabulary.

What is expected after the assignment? A suggested post-reading activity is to develop several conclusions based on the material covered. Students could then be divided into groups to discuss these statements.

For children who are poor in reading, the teacher can and should use other means to accomplish the objectives of the science course.